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(54) **EXPANDABLE KEYBOARD**

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G06F 3/02 (2006.01)

(52) **U.S. Cl.**
CPC *G06F 3/0221* (2013.01); *G06F 3/0216* (2013.01)

(58) **Field of Classification Search**
CPC B41J 5/00; B41J 5/10; B41J 29/02; B41J 29/023; G06F 3/02; G06F 3/0221; G06F 3/0216
USPC 400/472–496
See application file for complete search history.

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(57) **ABSTRACT**

A keyboard includes a housing, a frame surrounding the housing, and a plurality of keys arranged in a plurality of columns and a plurality of rows. The keyboard is movable between a closed configuration and an expanded configuration, and the keys are accessible in both the closed and expanded configurations.
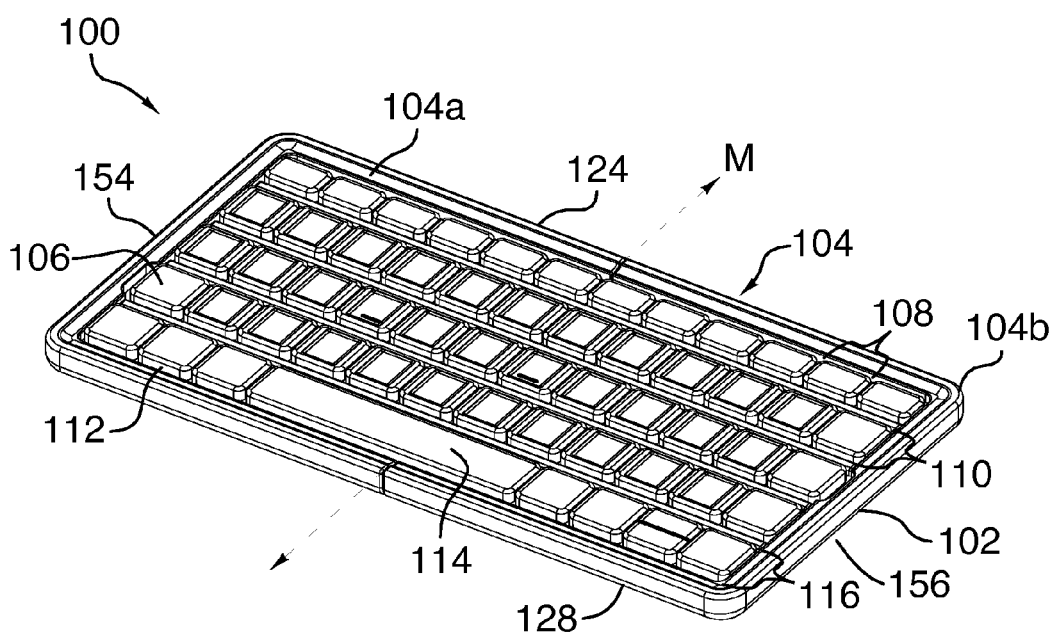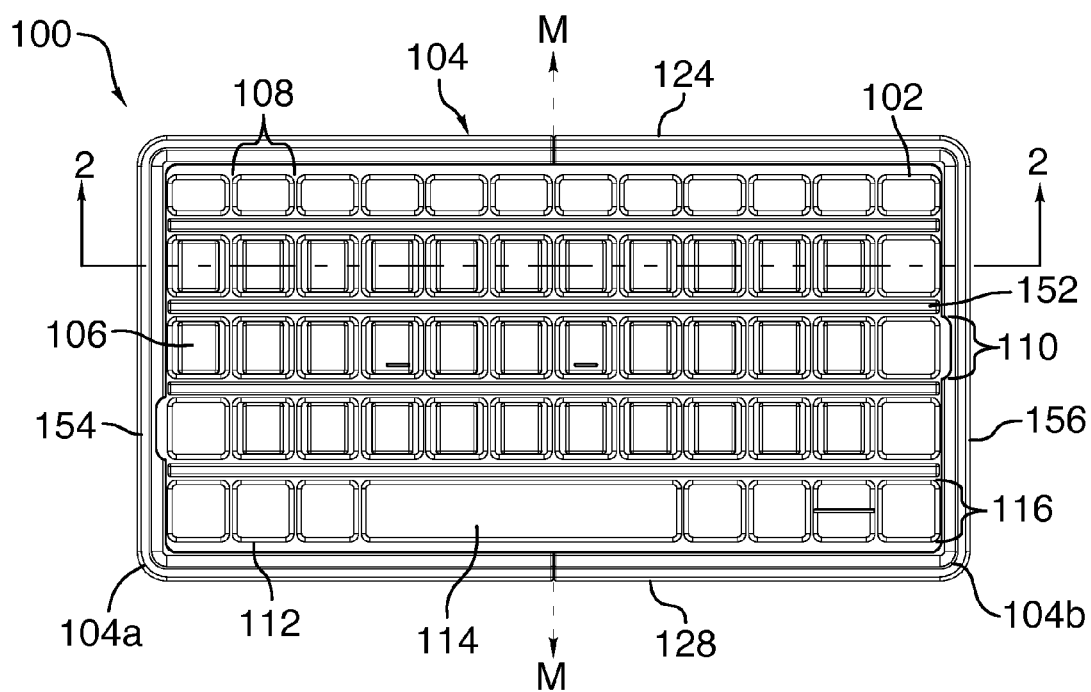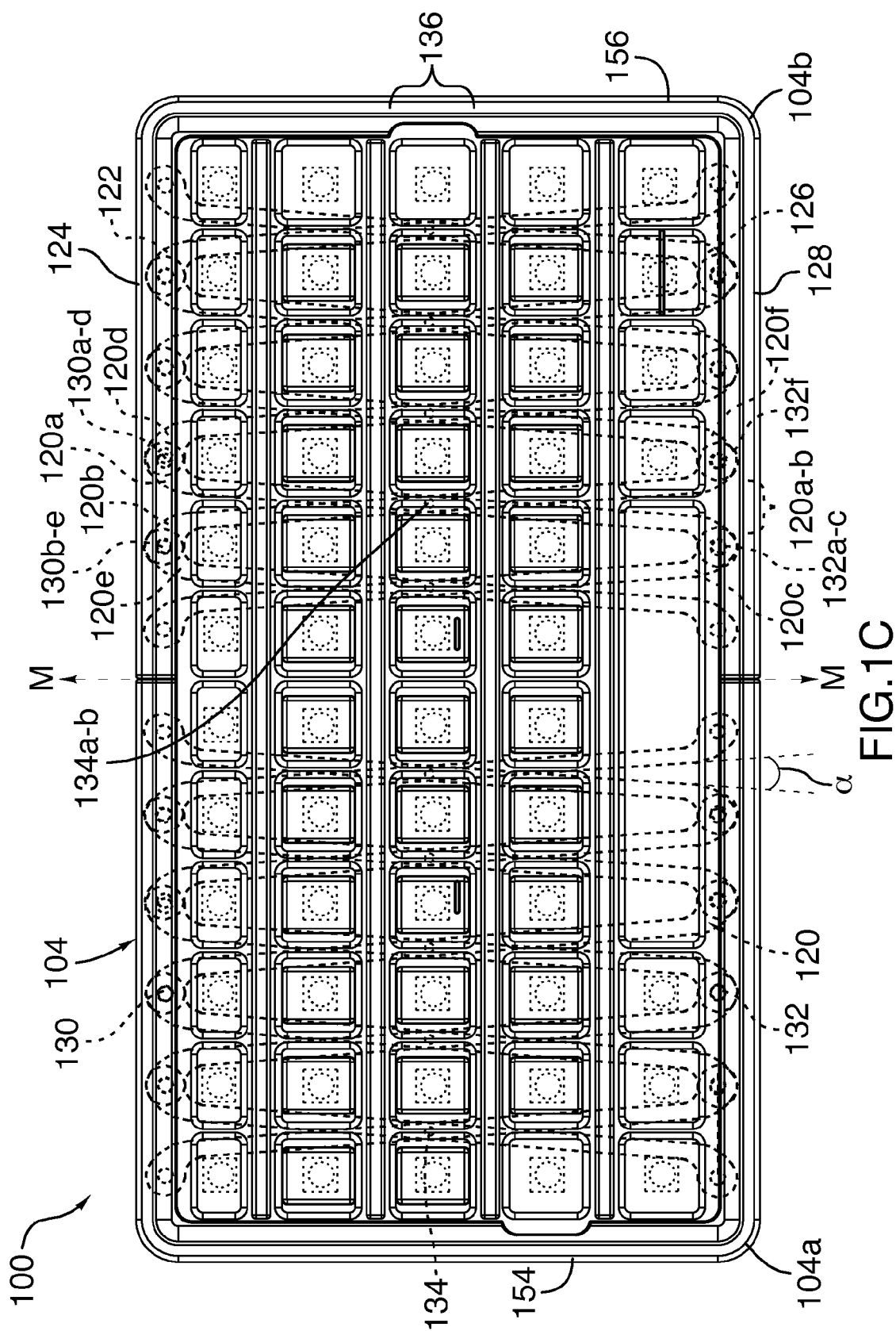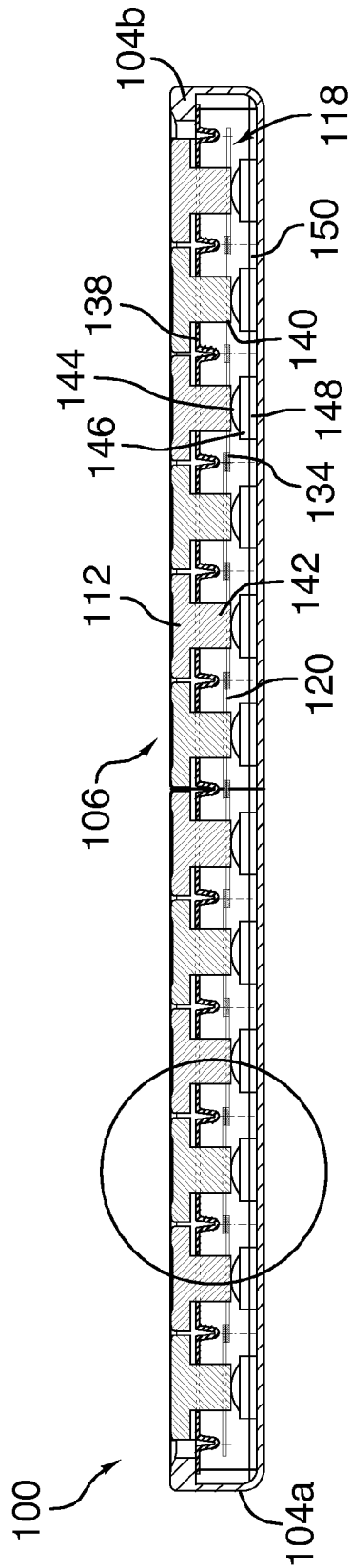
17 Claims, 8 Drawing Sheets

FIG.1A

FIG.1B

FIG.1C
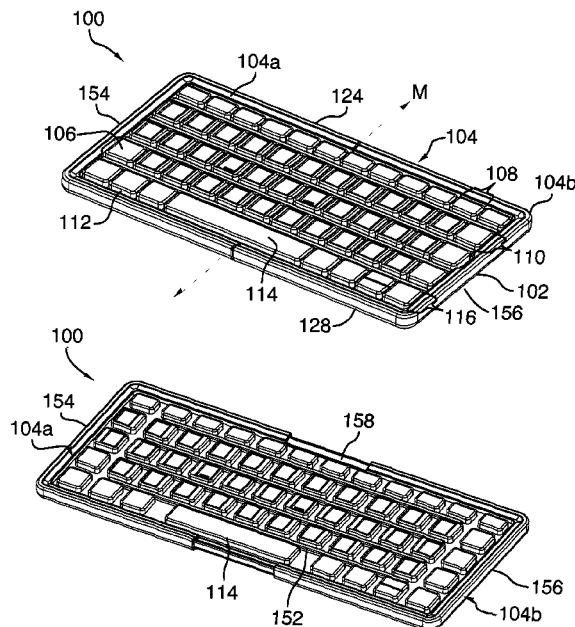
FIG.2A
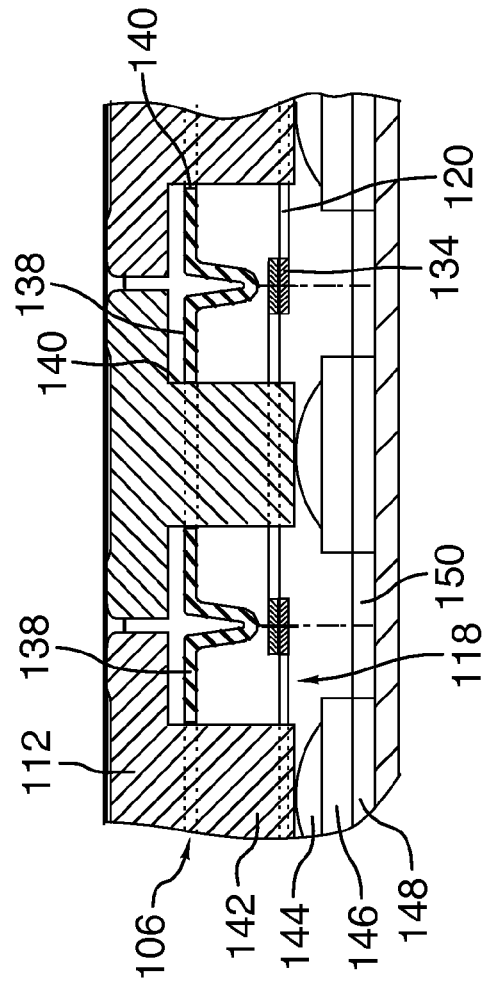
FIG.2B
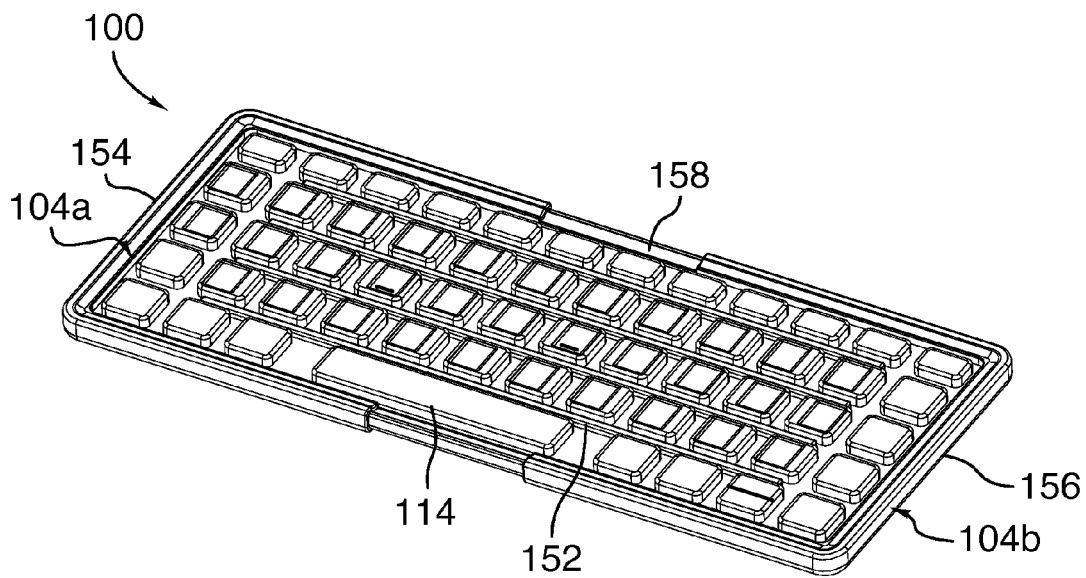
FIG.3A

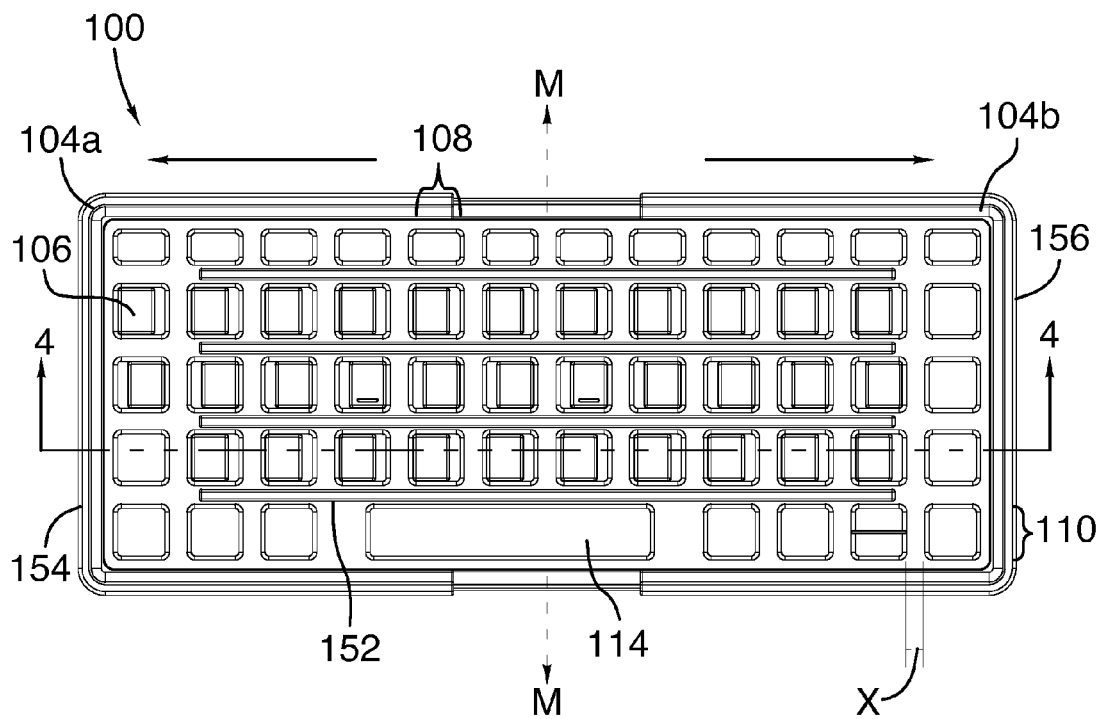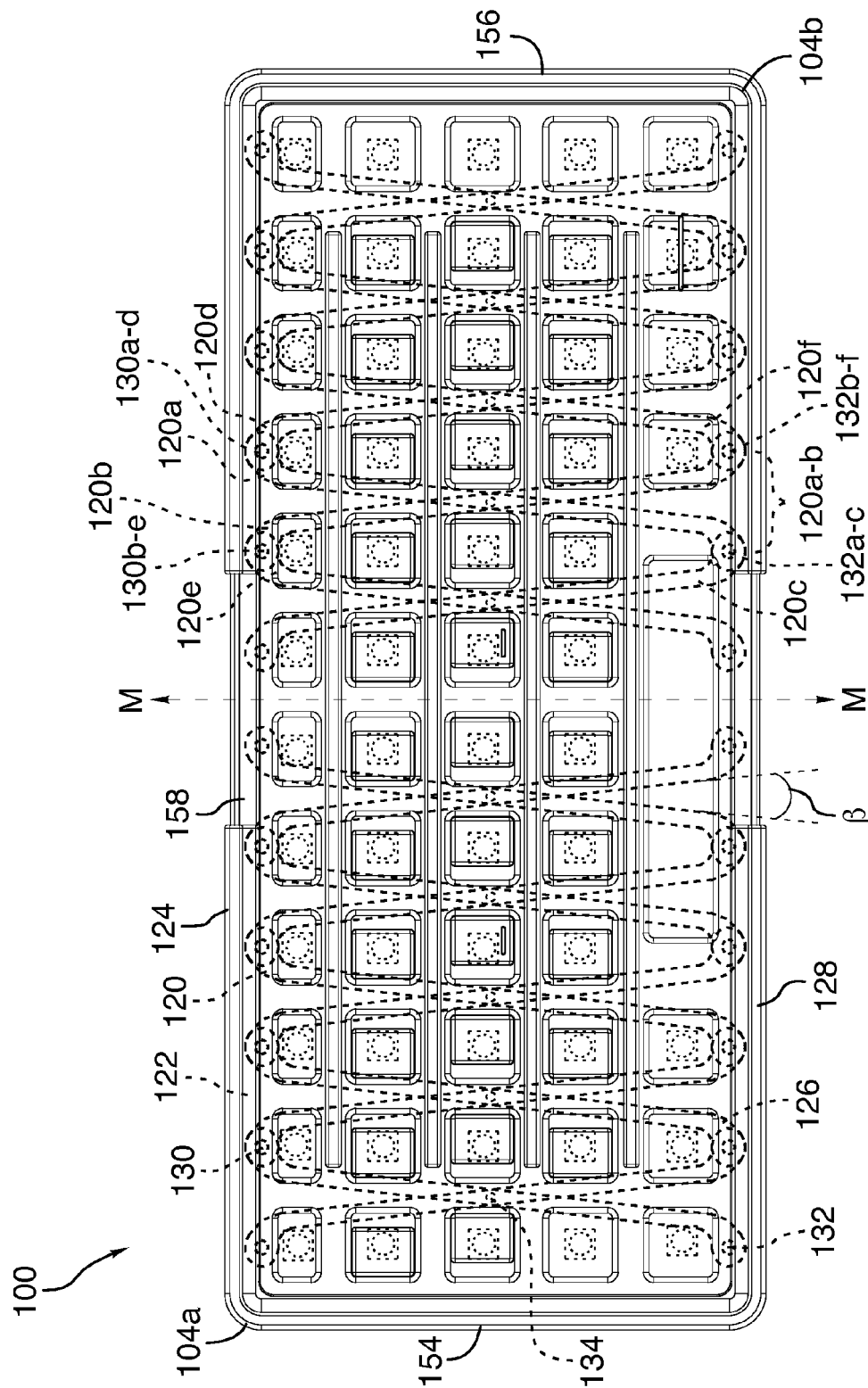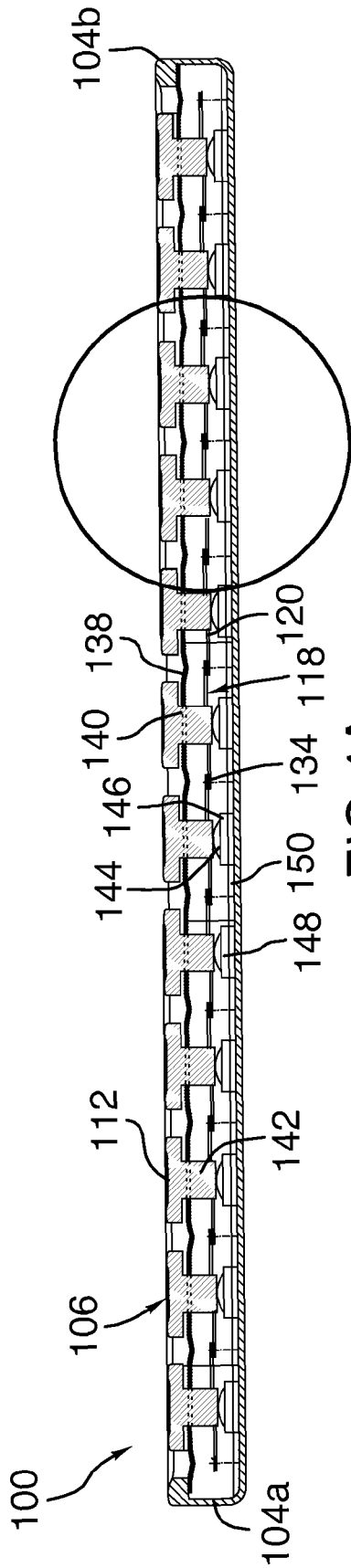**FIG.3B**

FIG.3C

FIG.4A

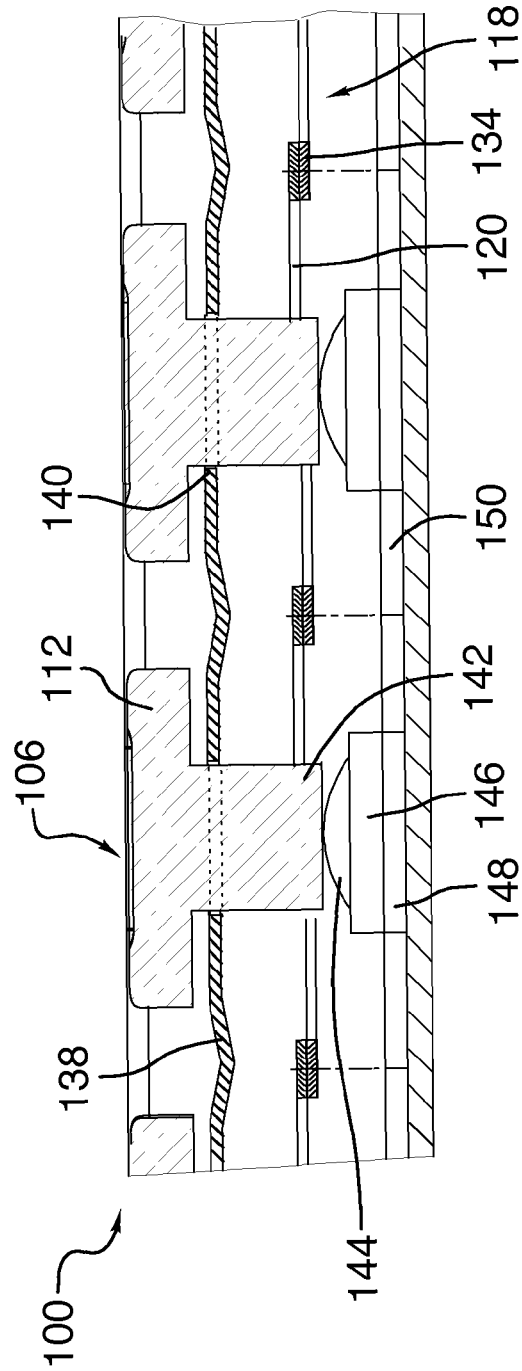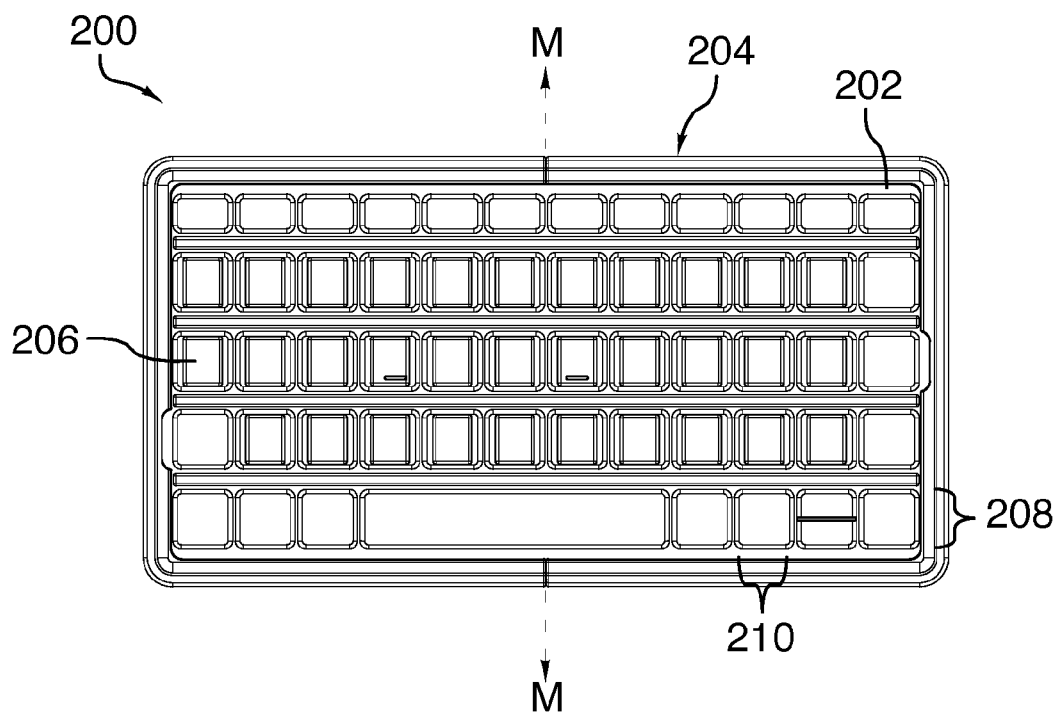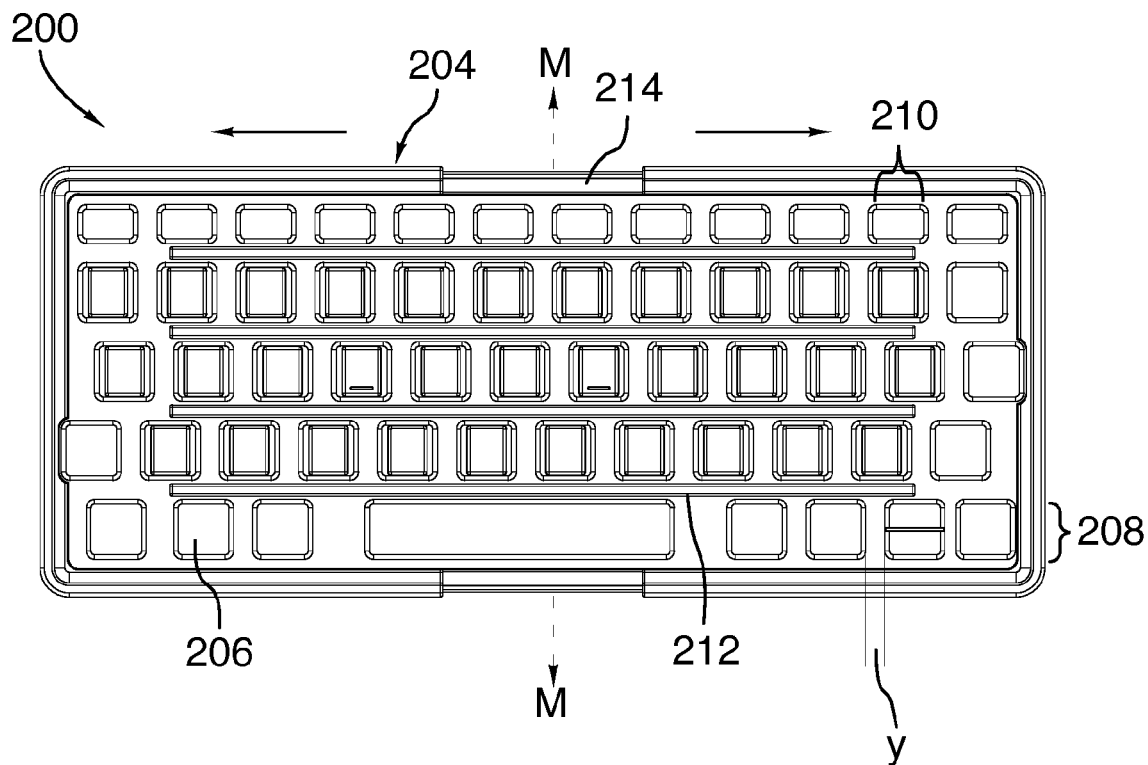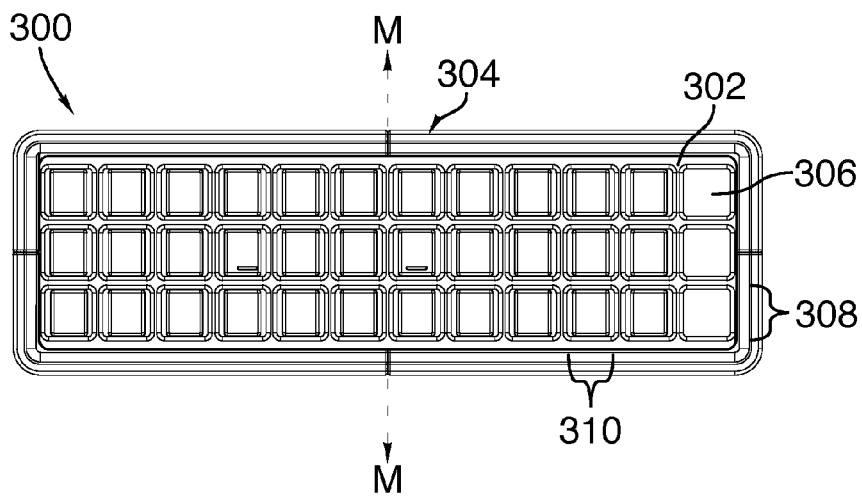FIG.4B

FIG.5

FIG.6

FIG.7

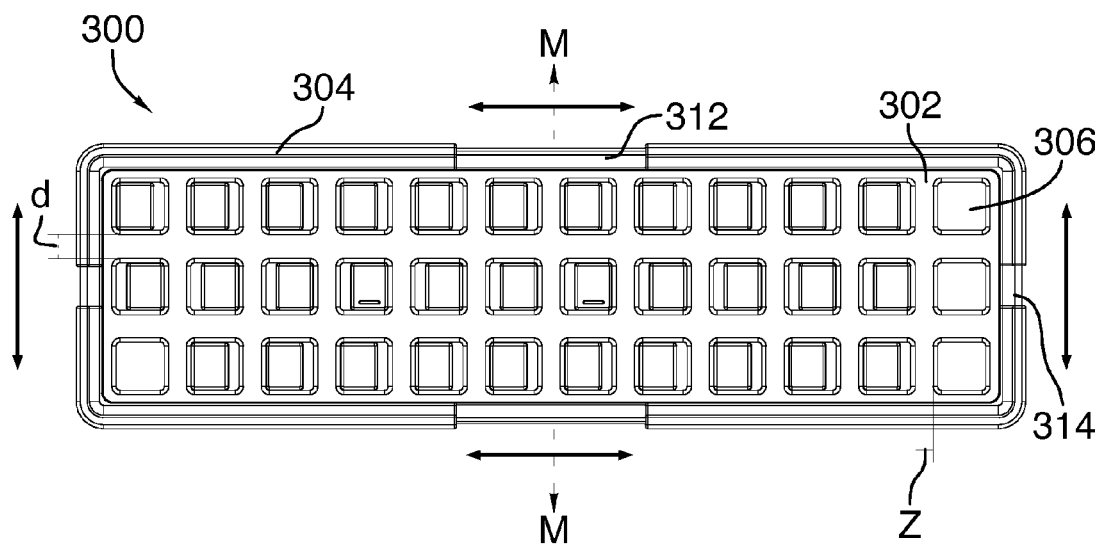

FIG.8

EXPANDABLE KEYBOARD

BACKGROUND OF THE DISCLOSURE

This disclosure is directed to keyboards, and more specifically to a keyboard accessory for an electronic device. Conventional keyboard accessories for laptops, tablet devices and/or handheld devices are typically reduced in size so as to be portable and easy to carry. While such keyboards are lightweight and portable, the typing surface and key size is also reduced, which may make it difficult to type or reduce comfort for some users. Further, some users may wish to utilize a reduced size keyboard in some instances (such as at an airport or in a restaurant, for example), but may desire to use a full sized keyboard in other instances (such as when working at home, for example).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a top perspective view of an expandable keyboard in a closed configuration in accordance with the present disclosure;

FIG. 1B is a top plan view of the keyboard in the closed configuration;

FIG. 1C is a top plan view of the keyboard showing an expansion mechanism housed within the keyboard when the keyboard is in the closed configuration;

FIG. 2A is a cross-section front view of the keyboard in FIG. 1B taken along the line 2-2 and in the direction indicated;

FIG. 2B is a close up cross-section front view of the keyboard in FIG. 2A;

FIG. 3A is a top perspective view of the keyboard in an expanded configuration;

FIG. 3B is a top plan view of the keyboard in the expanded configuration;

FIG. 3C is a top plan view of the keyboard showing the expansion mechanism housed within the keyboard when the keyboard is in the expanded configuration;

FIG. 4A is a cross-section front view of the keyboard in FIG. 3B taken along the line 4-4 and in the direction indicated;

FIG. 4B is a close-up cross-section front view of the keyboard in FIG. 4A;

FIG. 5 is a top plan view of another embodiment of an expandable keyboard in a closed configuration;

FIG. 6 is a top plan view of the keyboard in FIG. 5 in an expanded configuration;

FIG. 7 is a top plan view of yet another embodiment of an expandable keyboard in a closed configuration; and

FIG. 8 is a top plan view of the keyboard in FIG. 7 in an expanded configuration.

DETAILED DESCRIPTION

It will be appreciated that for simplicity and clarity of illustration, where considered appropriate, reference numerals may be repeated among the figures to indicate corresponding or analogous elements. In addition, numerous specific details are set forth in order to provide a thorough understanding of the embodiments described herein. However, it will be understood by those of ordinary skill in the art that the embodiments described herein may be practiced without these specific details. In other instances, well-known methods, procedures and components have not been described in detail so as not to obscure the embodiments described herein.

Also, the description is not to be considered as limiting the scope of the embodiments described herein.

Turning now to FIGS. 1A and 1B, a keyboard 100 in accordance with the present disclosure is shown in a closed configuration. The keyboard 100 includes a housing 102, a frame 104 surrounding the housing, and a plurality of keys 106 arranged in a plurality of columns 108 and a plurality of rows 110. Both the frame 104 and the housing 106 are composed of a rigid material such as a plastic or other similar material that will allow the keyboard 100 to maintain its shape. The frame 104 surrounds an outer periphery of the housing 106 and in the keyboard 100, includes a first half 104a and a second half 104b. In the present keyboard 100, the first half 104a and the second half 104b are substantially C-shaped portions (with the first half 104a and the second half 104b being mirror-images of each other) that meet each other at a midline M of the keyboard, as seen in FIG. 1B.

As will be described in further detail below, the keyboard 100 is movable between the closed configuration and an expanded configuration (FIG. 2), with the keys 106 being accessible in both the closed and expanded configurations. Each of the keys 106 has a corresponding key cap 112 that can have an associated indicia printed thereon, such as an alphabetic character, a number, a function, and/or a symbol, for example. The indicia of each of the keys 106 in a corresponding one of the columns 108 can be either vertically aligned with or vertically offset from an adjacent one of the keys in the corresponding column. The key caps 112 are manufactured from a rigid material such as a thermoplastic or other similar material that provides tactility to a user and that maintains its shape during use. In the present keyboard 100, the keys 106 are substantially rectangular in shape, although it is appreciated that the keys are not limited to such a configuration.

In the closed configuration, each of the keys 106 in a corresponding one of the columns 108 is vertically aligned with each other. In other words, in the closed configuration of the keyboard 100, each of the keys 106 in column 108a, for example, are vertically aligned with each other, as are the keys in column 108b, 108c, and so forth. The only exception to this aligned arrangement is a space bar 114 in a bottom row 116 of the keyboard 100: as seen in FIG. 1B, the space bar 114 extends the width of five keys 106 and accordingly is not vertically aligned with those keys that are located in the columns directly above the space bar. However, the outer edges of the space bar 114 are aligned with outer edges of corresponding columns, as shown in FIG. 1B.

Referring now to FIGS. 1C, 2A and 2B, the keyboard 100 includes an expansion mechanism 118 (shown in broken lines in FIG. 1C) provided in the housing 102 and configured for enabling movement of the keyboard between the closed and the expanded configurations. In the present disclosure, the expansion mechanism 118 is a "scissor-like" mechanism that includes a plurality of arms 120 that are each attached to the frame 104. However, it is recognized that alternative sliding mechanisms for expanding and closing the keyboard may be suitable, such as an over-center spring mechanism, for example.

More specifically, each arm 120 is attached at a first end 122 thereof to a first or top side 124 of the frame 104, and at a second end 126 thereof to a second or bottom side 128 of the frame, where the top and bottom sides of the frame are substantially parallel to each other and spaced apart by an amount approximate to a length of the arms 120. The arms 120 are secured to the top side 124 of the frame by a corresponding top pivot pin 130, and are secured to the bottom side 128 of the frame by a corresponding bottom pivot pin 132. To form a scissor or lattice-like structure, pairs of the arms 120 are

joined together at their respective midpoints by a central pivot pin **134**, as shown in FIG. 1C, such that the attached pairs of arms form an "X" shape.

In the closed configuration shown in FIG. 1C, the pairs of arms **120** define an angle a at the central pin **134**. The location of the central pin **134** corresponds to a middle row **136** of the keyboard **100**. To further maintain fluid movement and to provide additional connection between adjacent pairs of arms **120**, each arm **120** in a corresponding pair is further connected to an adjacent arm in an adjacent pair at the top and bottom pivot pins **130**, **132**.

For example and as shown in FIG. 1C, arms **120***a* and **120***b* form a pair **120***a-b*, and are secured together by a central pin **134***a-b*. To further secure the pair of arms **120***a-b* to adjacent arms **120**, the second end **126** of arm **120***a* is secured to adjacent arm **120***c* at bottom pin **132***a-c*, and the first end **122** of arm **120***a* is secured to adjacent arm **120***d* at top pin **130***a-d*. Similarly, the first end **122** of arm **120***b* is secured to adjacent arm **120***e* at top pin **130***b-e*, and the second end **126** of arm **120***b* is secured to adjacent arm **120***f* at bottom pin **132***b-f*. A similar arrangement continues throughout the expansion mechanism **118** between adjacent arms **120** and accordingly will not be further described herein. Such a configuration ensures indirect and/or direct connection between the arms **120** and enables fluid and smooth transitioning of the keyboard between the closed and expanded configurations.

Referring now to FIGS. 2A and 2B, the expansion mechanism **118** is located within the housing **102** of the keyboard **100**, and is arranged such that it does not interfere with the functionality of the keys **106**. To hide the expansion mechanism **118** from view, the keyboard **100** includes a bellows or webbing **138** that surrounds the keys **106** and in addition to hiding the expansion mechanism **118** from external view, also prevents ingress of dirt and/or moisture into the keyboard **100**. The bellows **138** defines a plurality of openings **140** configured to receive a corresponding one of the keys **106**. More specifically, each of the keys **106** includes a key stem or actuator **142** extending from the key cap **112**, and the openings **140** are sized and arranged to receive a corresponding one of the key stems. Although the bellows **138** in the present keyboard **100** is a single piece configured to bend/flex during opening and closing of the keyboard, it can also be a plurality of sections that slide relative to each other during opening and closing of the keyboard (not shown).

Each of the key stems **142** is arranged in alignment with a corresponding dome **144** provided on a dome sheet **146**, which is located on top of a corresponding printed circuit board or PCB **148**. As seen in FIGS. 2A and 2B, each column **108** of keys **106** includes its own PCB **148** and dome sheet **146**, such that in the present disclosure, there are **12** PCBs, each PCB being in alignment with a corresponding one of the columns. Each PCB **148** includes one of the dome sheets **146**, which includes a corresponding dome **144** for each of the keys **106** (it is also appreciated that in other embodiments, there could be more than one key associated with each dome, although such a configuration is not shown or further described herein). To maintain communication between the PCBs **148**, each PCB is connected to its adjacent PCB by a flex **150**.

The expansion mechanism **118** is provided between the bellows **138** and the domes **144**, and more specifically is arranged such that the key stems **142** are arranged between corresponding pairs of arms **120** of the mechanism. It is contemplated that this arrangement prevents the keys **106** from interfering with the mechanism **118** during operation thereof, which will be described in further detail below.

Operation of the keys **106** of the keyboard **100** is similar to that of conventional physical keyboards. Specifically, when a user actuates one of the keys **106**, the key cap **112** is depressed, causing the key stem **142** to engage the corresponding dome **144**. Upon engagement, a circuit (not shown) on the dome sheet **146** is closed and a signal is sent to the PCB **148**, which is in communication (via Bluetooth or other wireless capability) with a processor on a corresponding device (not shown). The character associated with the actuated key is then input and shown on a display screen of the device. It is contemplated that the keyboard **100** can also be in wired communication with the corresponding device via a USB plug or similar hardwired connection.

When the keyboard **100** is in the closed configuration, as shown in FIGS. 1A-2B, the rows **110** of keys are arranged such that adjacent keys are in contact with each other; in other words, there is "zero gap" between adjacent keys in the same row, thus providing a small form factor when the keyboard is in the closed configuration. Although not required, in the present disclosure, the rows **110** of keys are separated by frets **152**, which can be made of metal, plastic, or any other durable and rigid material. Frets **152** can be a useful tactile guide for the user while typing to help identify where the next row of keys is located, for example.

The columns **108** are arranged such that the keys **106** in each column are vertically aligned with each other. As indicated above and seen in FIG. 1B, the space bar **114** is arranged such that it is the same width as five of the keys **106**, and is placed in the bottom row **116** of the keyboard such that the keys **106** on either side thereof are still in vertical alignment with the keys located directly above them and in the same column **108**. The space bar **114** shares a common PCB **148** and dome sheet **146** with the keys **106** in the sixth column **108** of keys (identified in FIG. 1B as column **108***f*), although it is contemplated that other configurations may be possible.

The present keyboard **100** is configured for use as a transportable accessory for a portable device. Most conventional accessory keyboards have been reduced in size to increase ease of portability and travel. However, such a reduced size may result in user discomfort due to typing on such small key surfaces, and others may be used to a conventional-sized keyboard and find typing difficult on a reduced size keyboard. In still other scenarios, some users may wish to use the portable or reduced size keyboard in some instances but may desire a full-size keyboard in other instances.

In the present disclosure, the keyboard **100** can be functional in both the closed configuration (as shown and described above with respect to FIGS. 1A-2B), and in the expanded configuration, as will be described below. While the keyboard **100** is in the closed configuration, the user can touch-type thereon (i.e., with four fingers of each hand located on keys **106** and the thumbs of each hand located on the space bar **114**). As the keyboard **100** is smaller in size when in the closed configuration, the keyboard can be used in locations where space is an issue, and can also more easily fit into a user's bag or luggage, for example.

When the user wishes to access the full-sized keyboard, the present keyboard **100** can be transitioned from the closed configuration to the expanded configuration by utilizing the expansion mechanism **118** described above. Specifically, as shown in FIGS. 3A-3C, to use the keyboard **100** in the expanded configuration, the user grasps the keyboard at first and second sides **154**, **156** of the frame **104** (which are substantially perpendicular to the top and bottom sides **124**, **128** of the frame) and pulls in the direction of the arrows shown in FIG. 3B. As the keyboard **100** moves to the expanded con-

figuration, the frame **104** is divided into two oppositely moving components **104***a*, **104***b*, each of which slides along a rail **158** in the direction indicated.

As the keyboard **100** is moved to the expanded configuration, the columns **108** of keys **106** move apart from each other, with the columns of keys to the left of the midline M moving in a leftward direction, and the columns of keys to the right of the midline M moving in a rightward direction until the keyboard has reached its fully expanded configuration. As can be seen in FIGS. **3A** and **3B**, when the keyboard **100** is in the fully expanded position, the keys **106** in corresponding columns **108** remain in vertical alignment with each other, similar to the configuration of the columns **108** in the closed configuration, except that the columns of keys are now spaced apart from each other a distance "x". In the present keyboard **100**, the distance x is approximately 19 mm, which is a typical distance or pitch utilized in many conventional full size keyboards. However, it is appreciated that the distance x can be increased or decreased to suit the application.

During expansion of the keyboard **100**, the expansion mechanism **118** moves from a compact or closed configuration to an expanded configuration. More particularly, and as shown in FIGS. **3C-4B**, as the keyboard **100** expands, the arms **120** move in a scissor-like fashion such that the angle a defined by the pairs of arms **120** increases to an angle β.

Specifically, referring again to arms **120***a-f*, as the keyboard **100** expands, the expansion mechanism **118** starts to translate from the compact configuration to the expanded configuration, with the columns **108** of keys **106** moving apart from each other in column-by-column succession. As the pairs of arms (such as the pair of arms **120***a-b*) expand, the arms pivot about their respective central pin (such as the central pin **134***a-b*) until they reach a stopping or end point. Although not shown herein, the stopping point for each pair of arms **120** can be indicated by a stop or detent provided on the expansion mechanism **118** or along the rail **156**, for example, thereby ensuring that each column **108** of keys **106** has a specific limit and does not move past that limit.

The expansion or pivoting of the pairs of arms causes the first half and second half of the frame **104***a*, **104***b* to move along the rail **156** in opposite directions, thereby moving the columns **108** of keys **106** away from each other, starting with the column of keys closest to the midline M and ending with the column of keys closest to the first or second side **154**, **156** of the keyboard **100**. When a corresponding column **108** of keys **106** reaches its stopping point, it drives the next column of keys to move until it reaches its respective stopping point, and so on until each of the columns of keys is spaced apart the distance x from the adjacent column of keys.

Once the frame halves **104***a* and **104***b* have been pulled fully apart and reached the end of their travel along the rail **156**, the keyboard **100** is fully expanded and the columns **108** of keys **106** are now separated by the distance "x". To maintain the fully expanded configuration of the keyboard **100**, the rail **156** can include at least one end stop or detent (not shown) provided thereon that engages a corresponding opening in the frame **104** (not shown), although it is contemplated that other mechanisms may be possible to maintain the keyboard in the fully extended configuration (such as a tab and hook closure or a snap fit closure).

The flexes **150** connecting each of the columns **108** of keys **106** also expand during opening of the keyboard and are in fully extended positions (as seen in FIGS. **4A** and **4B**) when the keyboard **100** is in the expanded configuration. In addition, as the expansion mechanism **118** expands during movement of the keyboard **100**, the bellows **138** also unfolds and stretches to an extended position. Accordingly, the expansion

mechanism **118** is still hidden from external view when the keyboard **100** is in the expanded configuration.

FIGS. **5** and **6** depict an alternate embodiment of a keyboard **200** in accordance with the present disclosure. The keyboard **200** includes a housing **202** having a frame **204** that surrounds an outer periphery of the housing. The keyboard **200** further includes a plurality of keys **206** arranged in a plurality of rows **208** and columns **210**. The housing **202** includes an expansion mechanism and bellows (not shown) that allows the keyboard to transition from a closed configuration to an expanded configuration. The expansion mechanism in the keyboard **200** can also be a scissors-like mechanism similar to the expansion mechanism **118** described above or it can be a conventional spring-loaded slider mechanism, for example.

As can be seen in FIG. **5**, in the closed configuration, the keys **206** are arranged in vertically aligned columns **210**, and the rows **208** of keys are separated by frets **212**, similar to the keyboard **100**. The rows **208** of keys are also configured such that adjacent keys **206** are in contact with each other, thus creating a "zero-gap" row of keys.

When the keyboard **200** is transitioned to the expanded configuration (FIG. **6**) using the expansion mechanism, the frame **204** moves along a corresponding rail **214**, activating the expansion mechanism and causing the columns **210** of keys **206** to move such that they are separated a distance "y" from each other. In the expanded configuration, it can be seen that the keys **306** are arranged such that they are vertically offset from each other. In other words, the columns **210** of keys **206** are arranged in a staggered manner, similar to a conventional full-size keyboard. To provide such a staggered arrangement in the expanded configuration, the expansion mechanism for the keyboard **200** can be configured such that rows **208** of keys **206** are each provided on a single PCB and dome sheet (not shown). Accordingly, when the keyboard **200** is pulled apart, some of the rows **208** move in a leftward direction, and some of the rows move in a rightward direction. Similar to the expansion mechanism **118** described with respect to FIGS. **1-4B**, the PCBs can be attached to each other by a flex (not shown) that enables connection between the rows **208** in both the compact and expanded configurations. Alternatively, the expansion mechanism can be arranged such that each key **206** has its own PCB and dome sheet, with each PCB being attached to an adjacent PCB by a flex, thus enabling individual movement of the keys when the keyboard **200** transitions between the closed and expanded configurations.

FIGS. **7** and **8** show a further alternate embodiment of a keyboard **300** in accordance with the present disclosure. The keyboard **300** includes a housing **302** having a frame **304** that surrounds an outer periphery of the housing. The keyboard **300** also includes a plurality of keys **306** arranged in a plurality of rows **308** and columns **310**. In a closed configuration, as seen in FIG. **7**, the columns **310** of keys are arranged in a vertically aligned manner, and keys **306** in adjacent rows **308** and columns **310** are in direct contact with each other; in other words, keyboard **300** does not include frets or spacing between the rows of keys in the closed configuration. The keyboard **300** also includes an expansion mechanism (not shown) that allows for transition between the closed configuration and an expanded configuration (shown in FIG. **8**). As indicated above, the expansion mechanism for the keyboard **300** can be a scissor-like mechanism similar to the expansion mechanism **118** described above or can be a conventional spring-loaded slider mechanism or similar apparatus that enables controlled sliding, for example.

To move the keyboard **300** from the closed configuration to the expanded configuration, the user pulls the frame **304** apart in both a vertical direction and a horizontal direction, such that the frame slides in the horizontal direction along a rail **312** and the frame slides in the vertical direction along a rail **314**, as indicated by the arrows in FIG. **8**. Such movement causes the expansion mechanism to move the keys **306** such that the keys separate from each other in both the horizontal and vertical directions, resulting in columns **308** of keys **300** that are evenly spaced apart a distance "z" and rows **310** of keys that are spaced apart a distance "d". The rows **310** and columns **308** of keys **300** are vertically and horizontally aligned. Detents or stops (not shown) can be provided within the frame **304** to lock the keyboard **300** in the expanded configuration. Although not shown, the expansion mechanism in the keyboard **300** can include separate PCBs and dome sheets for each of the keys **306**, with the PCBs being connected to each other by flex connectors (not shown). As the keyboard **300** transitions to the expanded configuration, the expansion mechanism expands and the flex connectors extend, allowing for controlled movement. The keyboard **300** can also include a bellows (not shown) similar to the bellows **138** described above, which hides the expansion mechanism from view in both the closed and expanded configurations.

The present keyboards **100**, **200**, and **300** each provide a portable accessory that can be used in both closed and expanded configurations. Alternatively, it is appreciated that the keyboards **100**, **200** and **300** could be configured such that they are only functional in the expanded configuration, for example when the user places the keyboard in a bag or purse in the closed configuration, the keyboard is not functional, but when the user removes the keyboard and expands the same, it becomes operational. The keyboards **100**, **200**, **300** each include an internal expansion mechanism that allows for controlled and precise movement of the columns/rows of keys between the closed and expanded configurations.

While a particular embodiment of the present keyboard has been described herein, it will be appreciated by those skilled in the art that changes and modifications may be made thereto without departing from the disclosure in its broadest aspects and as set forth below.

The invention claimed is:

1. A keyboard comprising:
   a housing;
   a frame surrounding the housing;
   a plurality of keys arranged in a plurality of columns and rows wherein all side edges of each of the keys comprise substantially straight side edges, each of the plurality of keys comprising an actuator extending from a bottom surface of the key; and
   an expansion mechanism provided in the housing and configured for enabling movement of the keyboard between fully-closed and expanded configurations, where each actuator is arranged between corresponding pairs of arms of the expansion mechanism, and
   wherein the keyboard is movable between the fully-closed configuration and the expanded configuration, the plurality of keys being accessible in both the fully-closed and expanded configurations and wherein the plurality of keys are functional regardless of whether the keyboard is in the fully-closed configuration or the expanded configuration.

2. The keyboard of claim **1** wherein in the closed configuration, each of the keys in a corresponding one of the columns is vertically aligned with each other, and in the expanded configuration, each of the keys in the corresponding one of the columns is vertically aligned with each other.

3. The keyboard of claim **1** wherein in the closed configuration, each of the keys in a corresponding one of the columns are vertically aligned with each other, and in the expanded configuration, each of the keys in the corresponding one of the columns are vertically offset from each other.

4. The keyboard of claim **1** wherein each of the keys includes a dome sheet having a corresponding dome, each of the domes being in registry with a corresponding one of the keys.

5. The keyboard of claim **4** wherein each of the keys includes an actuator and a key cap, the actuator configured for engaging a corresponding one of the domes upon actuation of the key.

6. The keyboard of claim **1** wherein each of the columns is associated with a flexible PCB, each of the keys in a corresponding one of the columns being in communication with the corresponding PCB.

7. A keyboard comprising:
   a housing;
   a frame surrounding the housing;
   a plurality of keys being arranged in a plurality of rows and a plurality of columns wherein all side edges of each of the keys comprise substantially straight side edges, each of the plurality of keys comprising an actuator extending from a botton surface of the key; and
   an expansion mechanism provided in the housing and configured for enabling movement of the keyboard between fully-closed and expanded configurations, where each actuator is arranged between corresponding pairs of arms of the expansion mechanism, and
   wherein the keyboard is movable between the fully-closed configuration and the expanded configuration, the keys being accessible in both the fully-closed and expanded configurations and wherein the plurality of keys are functional regardless of whether the keyboard is in the fully-closed configuration or the expanded configuration.

8. The keyboard of claim **7** wherein each of the keys in a corresponding one of the columns is vertically aligned in both the closed and the expanded configurations.

9. The keyboard of claim **7** wherein each of the keys in a corresponding one of the columns are vertically aligned in the closed configuration and vertically offset from an adjacent key in the expanded configuration.

10. The keyboard of claim **7** wherein each of the columns of keys is associated with a corresponding flexible PCB.

11. The keyboard of claim **7** wherein each of the rows of keys is associated with a corresponding flexible PCB.

12. The keyboard of claim **7** wherein each of the keys is associated with a corresponding flexible PCB.

13. A keyboard comprising:
   a housing;
   a frame surrounding the housing;
   a plurality of keys arranged in a plurality of columns and a plurality of rows wherein all side edges of each of the keys comprise substantially straight side edges, each of the plurality of keys comprising a key cap and an actuator extending from a bottom surface of the key cap;
   a plurality of flexible PCBs, each PCB configured to correspond with one of the columns; and
   an expansion mechanism provided in the housing and configured for enabling movement of the keyboard between fully-closed and expanded configurations, where each actuator is arranged between corresponding pairs of arms of the expansion mechanism; and
   an expandable layer surrounding each of the plurality keys, the expandable layer comprising a plurality of regions

each receiving a corresponding one of the actuators, the expandable layer being situated below a bottom surface of the key cap and above the expansion mechanism,

wherein the keyboard is movable between the fully-closed configuration and the expanded configuration, the keys being accessible in both the fully-closed and expanded configurations, wherein the plurality of keys are functional regardless of whether the keyboard is in the fully-closed configuration or the expanded configuration, and wherein the expandable layer is in a contracted state when the keyboard is in the fully-closed configuration and is in an expanded state when the keyboard is in the expanded configuration.

14. The keyboard of claim **13** wherein each of the PCBs is connected to an adjacent PCB by a flex.

15. The keyboard of claim **13** wherein in the closed configuration, each of the keys in a corresponding one of the columns is vertically aligned with each other.

16. The keyboard of claim **13** wherein in the expanded configuration, each of the keys in a corresponding one of the columns are vertically offset from each other.

17. The keyboard of claim **13** further including a bellows in the housing configured for concealing the expansion mechanism.

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